

Human Health Monitoring System Using IoT and Cloud Technology - Review

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ABSTRACT: In India, everyday many lives are affected because of the patient's ignorance. Also real time parameters are not efficiently measured in the clinic as well as in hospitals. Sometimes it will be difficult for patients to visit hospitals frequently to keep a track on their health conditions. Mean while continuous monitoring of patients by the doctor is also not possible. This proposed work will address such situations by which measuring and monitoring of various parameters like ECG, heartbeat, temperature, humidity and fall detection etc can be known by the human being easily. The results can be recorded using Arduino Uno R3 and displayed on a LCD display. Also the results can be sent to server using Wifi module. Doctors can login to a website, access and view those results anytime and anywhere.

KEYWORDS: Aurdino controller unit, rectifiers, relays, voltage regulators, sensors, transformers, IoT, Wifi modems, MEMS, Aurdino software.

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1. INTRODUCTION

In a hospital health care monitoring system is necessary to monitor the patient's physiological parameters. Although present systems allow continuous monitoring of patient vital signs, these systems require the sensors to be placed bedside monitors or PCs, and limit the patient to his bed. A real-time monitoring system of some critical vital signs will be implemented. Such a system may help the doctor or people in the family to monitor the emergency alarm from patients. In this review, we consider three parameters of the vital signs which are Pulse rate, Human body temperature and electrocardiogram (ECG). The data helps to prevent and protect the patients. Wireless technology is used in many applications that have become a part of human activities such as agriculture, military, medical care, smart home system etc. Distinctly, wireless sensor networks (WSN) play a crucial role in such monitoring systems, for the reason that WSN can offer some advantages over other types of wireless systems, especially its scalability and flexibility of architecture. In this study, a group of sensors have been implemented for measuring Pulse rate, body temperature and electrocardiogram (ECG) with real-time monitoring system based on ZigBee wireless network. This study incorporates sensors to measure parameters like body temperature, heart beat rate and IR pulse rate sensors. A micro-controller board is used for analyzing the inputs from the patient and any abnormality felt by the patient causes the monitoring system to give an alarm and the SMS to the doctor and concerned authorities.

Also, all the process parameters within an interval selectable by the user are recorded to the common

computer. This is very useful for future analysis and review of patient's health condition. Mobile phones are used as barcode decoder for medicinal care as an extension to monitoring schemes. In order to provide better and more comprehensive healthcare services, Barcode decoder can be used to verify and assist out patient in the medical administration process. [1]
Android based body area network for the evaluation of medical parameters, there are various vital parameters in this system such as electrocardiogram (ECG), an ECG records the heart's rhythm and activity on a moving strip of paper or a line on a screen, pulse oximeter, a device that measures the oxygen saturation of arterial blood in a subject by utilizing a sensor attached typically to a finger, toe, or ear to determine the percentage of oxyhemoglobin in blood pulsating through a network of capillaries, plethysmograph is an instrument for measuring changes in volume within an organ or whole body (usually resulting from fluctuations in the amount of blood or air it contains) and fall detection. The tele-medical system is the system which focuses on the measurement and evaluation of these vital parameters. [2]

Communication and security in health monitoring systems have big challenges. In view of the future internet of things (IoT), these challenges could be addressed by improving the design of equipment and devices. This review is focused on existing communication protocols and security issue related to pervasive health monitoring by explaining their

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limitation, challenges, and possible solutions. [3]

It is important that there must be good networks communication between doctor and patient, so that doctor should be able to monitor the health condition of the patient. Sensors are used to monitor the patient's health. These sensors are relayed to the prior devices through the transmitter and then to the end user. [4]

Set of non-invasive physiological sensors are connected to a cell phone through IoT, which stores, transmits and analyses the physiological data and then presents it to the user in an appropriate form. To monitor the patient's oxygen level in the blood and pulse rate during sleep an instrument oximeter could be used [5].

Internet of things (IoT), monitoring the patient's health using web services and cloud computing technology by the android application. ECG android application is developed for the healthcare monitoring, which is based

on internet of things & cloud .which provides the end user with visualization of their electro cardiogram (ECG) waves and data logging functionality in the background. The logged data can be uploaded to the user's private centralized cloud which can be accessed by the patients as well as doctors. It is explained about some fundamental concepts of IoT, microcontroller, signal processing, communication protocols, secure and efficient mechanisms for large file transfer, data base management system, and the centralized cloud. [6]

A raspberry pi based device is developed for collecting the data from sensor (sensors like temperature, blood pressure, oximeter etc), these signals from patients will be sent to the doctor to diagnose the patients health. A web based application has been developed for both patients and doctors through which they can even communicate with each other. This system could be more useful for the people staying in rural areas.[7]

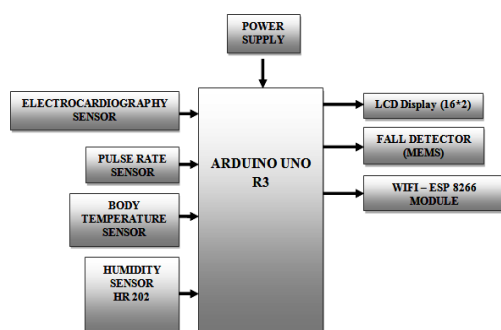


Fig 1:Block diagram.

3. METHODOLOGY:

Following Figures 1 & 2 shows main functional block diagram and schematic power supply circuit diagram of proposed work respectively, each block consist various circuit components which performs various function, these functions are explained in the preceding pages.

HARDWARE COMPONENTS USED

- Arduino Uno R3
- Temp Sensor
- Heart Beat Sensor
- Electrocardiography (ECG) Sensor
- Humidity Sensor
- MEMS Sensor
- Wifi Modem
- 16x2 Lcd Display

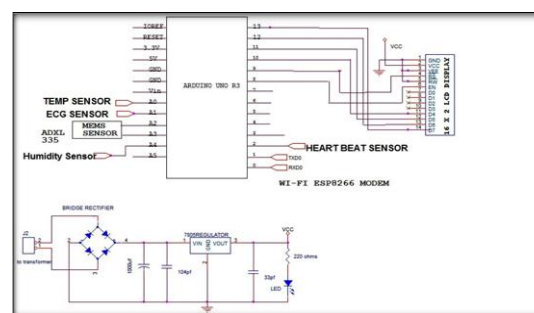


Fig 2:Schematic diagram and power supply circuit.

SOFTWARE USED

- Arduino Uno R3
- Embedded C Language

Arduino Uno r3

The Uno is a microcontroller board based on the ATmega328P, having 14 digital i/o pins, 6 pins can be used as PWM outputs, 6 pins analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It can be interfaced to any computer with a USB cable or power it with a AC-to-DC adapter or battery for power supply. Details of device and connections are shown below in figure 3 and 4.

Liquid Crystal Display (LCD)

LCD is the combination of solid and the liquid materials. It utilizes liquid crystal to produce an image. Liquid crystal displays are super-thin technology display screen that are generally used in many devices and

electronic gazettes. LCD's technologies allow displays to be much thinner compared to cathode ray tube (CRT). Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. Light is projected from a lens on a layer of liquid crystal screen. This colored light with the grayscale image of the crystal forms the colored image.

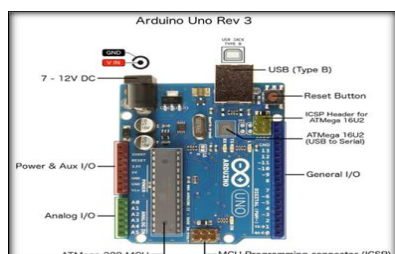


Fig 3: Arduino Uno Rev 3 board.

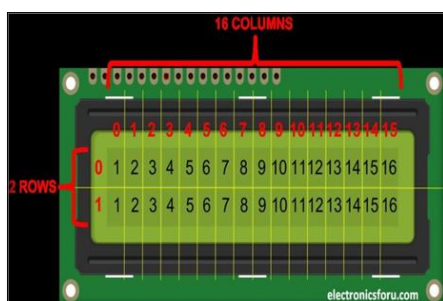


Fig 5: Liquid crystal display.

ESP 8266 WiFi Module

The ESP8266 WiFi module is an economical Wi-Fi microchip with full TCP/IP stack and microcontroller compatibility device. It is manufactured by Shanghai-based Chinese manufacturer. This chip is first came to the attention of western makers in August 2014 with the ESP-01 module, manufactured by a third-party manufacturer ie Ai-Thinker. This module will access the microcontrollers using Hayes-style commands. ESP8266 WiFi module chip and pin details are shown in figure 7 and 8 as below.

Power Supply

Regulated power supply is ideal for variable bench dc power supply. The dedicated portable power supply is quite comfortable to provide 5V or 12V range power supply requirement. Most digital logic circuits and processors need a 5 volt dc power supply. Usually to start with an unregulated power supply ranging from 9 volts to 24 volts DC power supply, the Beginner Kit and

This image is then displayed on the screen. Device and its connection with Arduino is shown in figure 5 and 6.

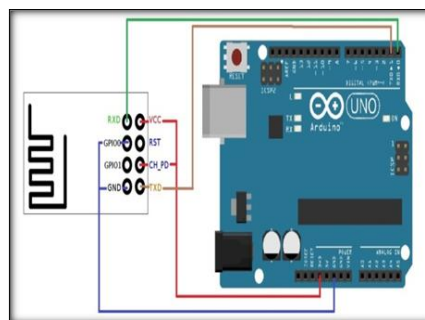


Fig 4: Arduino Uno connection to ESP8622.

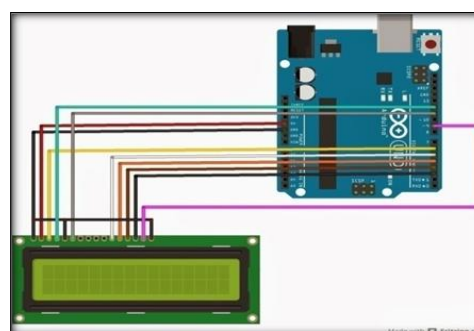


Fig 6: LCD Connected with

the Microcontroller Beginner Kits are used. LM7805 IC is used to get 5 volt dc power supply. The LM7805 is having simple connection to use. It's positive lead of unregulated DC power supply is connected to the input pin and the negative lead to the common pin. When the power is turn on, then 5 volt supply is available at the output pin. Basic regulated power supply circuit and LM7805 IC pin details are shown below in figure 9 and 10.

SENSORS

Heart Beat Sensor

Heart beat is sensed by using a high intensity type LED and LDR. The setup described here uses a red LED for transmitted light illumination and a LDR as detector. The detectors photo current (AC Part) is converted to voltage and amplified by an operational amplifier (LM358). Output is given to another non-inverting input of the same LM358; here the second amplification is done. The value is pre-set in the inverting input, the amplified value is compared with pre-set value if any abnormal condition occurs it will generate an interrupt to the controller at time. Schematic circuit diagram is shown in figure 11.

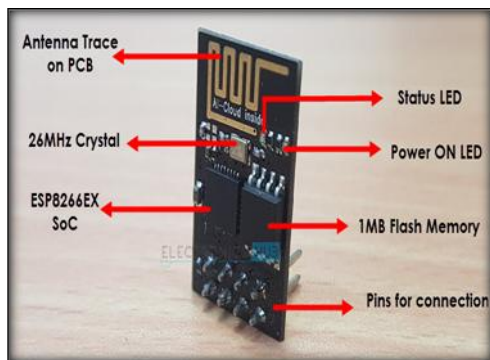


Fig 7: ESP8266 chip.

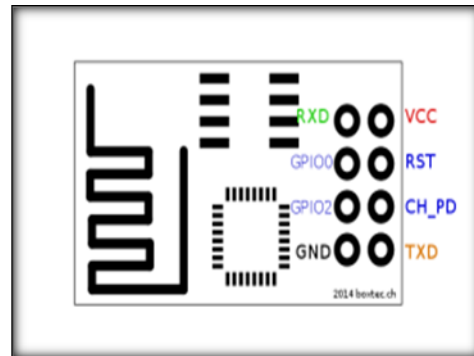


Fig 8: ESP8266 pin configuration.

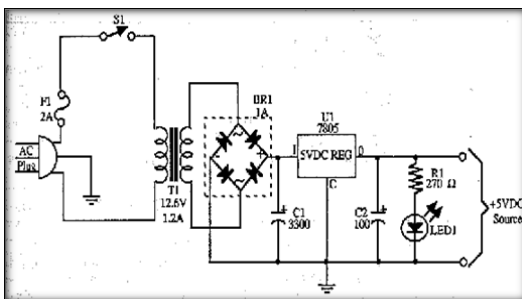


Fig 9: Circuit diagram of regulated power supply.

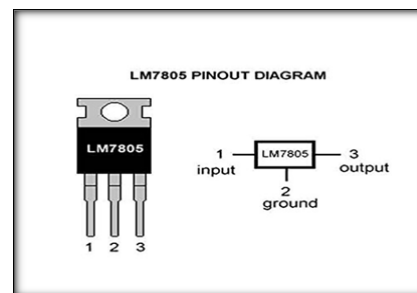


Fig 10: LM7805 pin diagram.

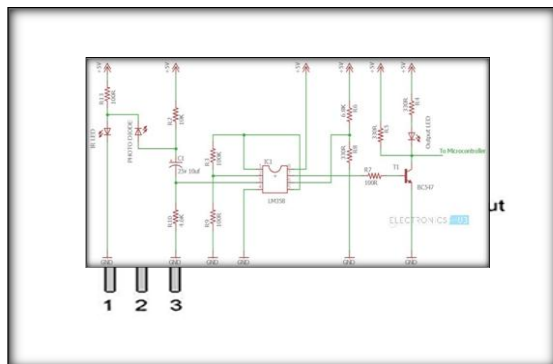


Fig 11: Circuit diagram of heart beat sensor.

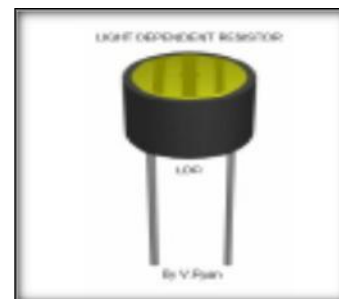


Fig 12: Basic model of LDR.

Light Dependent Resistors (LDR)

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. The resistance of the LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops to low value. When the light intensity is low the resistance of the LDR will be high. This

prevents the base current in the transistors. Basic model Of LDR is shown in figure 12.

Light Emitting Diode (LED)

A light-emitting diode (LED) is has incoherent narrow spectrum light, when it is electrically biased in the forward direction of the pn-junction. This effect is a form of electroluminescence. While sending a message

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in the form of bits such as 1, the data is sent to the receiver side correspondingly the LED glows representing the data is being received simultaneously when we send 8 as a data the LED gets off. Circuit diagram for LED is shown in figure 13.

Temperature Sensor

A temperature sensor is a thermocouple or a resistance temperature detector (RTD). The LM35 is commonly used temperature sensor that can be used to measure temperature. This sensor generates a high output voltage than the thermocouples and it does not require that the output voltage is amplified. The LM35 has an output voltage that is proportional to the existing temperature. The scale factor is $.01V/^{\circ}C$. The LM35 does not need any exterior calibration and maintains an exactness of $\pm 0.4^{\circ}C$ at room temperature and $\pm 0.8^{\circ}C$ over a range of $0^{\circ}C$ to $+100^{\circ}C$. One more significant characteristic of this sensor is that it draws just 60 micro amps from its supply. LM35 sensor pin and circuit diagrams are shown in figure 14 and 15.

Humidity Sensor

HR202 is a latest humidity sensor made from organic macromolecule materials; it can be used in many applications like hospitals, storage, workshop, textile

industry, tobaccos, pharmaceutical field, meteorology, etc. This sensor has low power consumption, wide measurement range and efficient performance with economic price. A HR 202 Humidity Sensor is shown in below figure 16.

ECG Sensor

The electrocardiogram (ECG) is a surface measurement of the human body blood pressure on the principle of electrical potential generated by electrical activity in cardiac tissue. The current flow will be in the form of ions and signals contraction of cardiac muscle fibers leading to the heart's pumping action.

The ECG is an important, non-invasive diagnostic tool which was introduced during the year 1913 with Einthoven's invention of the string galvanometer, Einthoven's recording is known as the "three lead" ECG, with measurements taken from three points on the body (defining the "Einthoven triangle" — an equilateral triangle with the heart at the centre.) The difference between potential readings from L1 and L2 is what is used to produce the output ECG trace. Schematic ECG amplifier circuit diagram is shown in below figure 17.

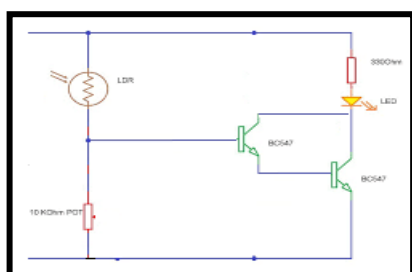


Fig 13: Circuit diagram of light sensor circuit.

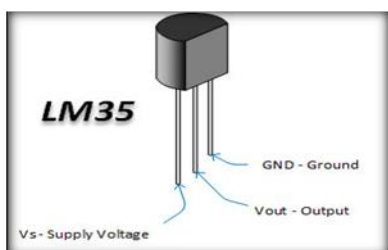


Fig 14: LM 35 sensor

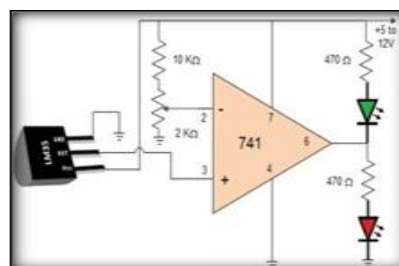


Fig 15: Circuit diagram of LM35



Fig 16: HR 202 humidity sensor

MEMS Sensor (Micro electro mechanical systems)

The ADXL335 is a microelectromechanical systems sensor. This sensor measures acceleration with a minimum full-scale range of ± 3 g tolerance. It can measure even the static acceleration of gravity in tilt-

sensing applications, also the dynamic acceleration resulting from motion, shock, or vibration. A typical ADXL335 MEMS sensor pin configuration is shown in below figure 18.

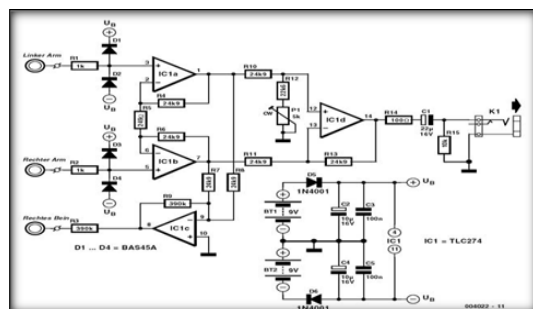


Fig 17: ECG amplifier circuit.

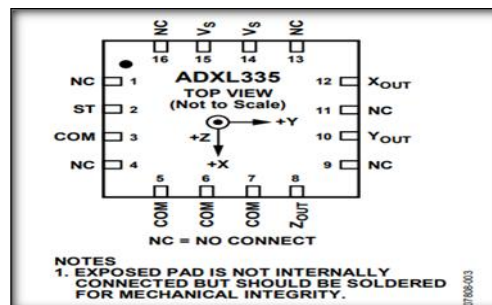


Fig 18: Pin configuration of ADXL335 MEMS sensor.

4. APPLICATIONS

Various applications of proposed work could be listed as follows.

- Home automation for underprivileged patients.
- Can be used for old age persons for regular check-up.
- Remote areas where there are no proper hospitals for health check-up.
- For regular monitoring of health at homes for medically challenged people.
- For better record of patients health through cloud monitoring system.

6. CONCLUSION

There are many other extensions possible to the current work that can be studied further. The direct extension is to use artificial intelligence in wireless sensor networks to explore simple parallel distributed computation, distributed storage, data robustness and auto classification of sensor readings to help the physicians in the early interpretation of diseases. Data encryption while transferring the data, paying attention to legal. It is obvious that proper application of this technology in the area of medical science would benefit the mankind to protect the human lives from unforeseen health complications in future. It is required to identify and resolve technical and non-technical challenges that are playing a vital role in the successful implementation of these medical technologies, which could realize the benefits of these technologies in monitoring the patient health. The successful implementation of mobile-based health monitoring will face many challenges such as increasing the accuracy of critical signals,

5. ADVANTAGES

Following are the few advantages where the proposed work could benefit in various aspects.

- Better patient engagement.
- Real-time data for care managers.
- The increased interest level of patients.
- Reduced healthcare cost.
- Healthcare analytics.
- Providing timely health alerts.
- Better chronic care management.
- Reduced scope for error.
- Enhanced drugs and medication management.
- Helping especially abled people.

and ethical aspects, user friendly, allowing the interaction between the system components, nomination and establishment of rules, guidelines and standards and proper policies regarding the use of these technologies particularly with respect to privacy and data security while sending critical patient signals are all important in the successful application of these systems across the globe must be considered.

interoperability between different systems, bandwidth limitations, quality of health services and battery life limited so on. By providing appropriate technical information and infrastructure such as adequate bandwidth, preparation of standard tools that provide maximum mobility, flexibility and efficiency for users, least obstacles which interrupts network communication, suitable communication protocol, and adoption of adaptable wireless technologies will help the person to take precautionary measures against health hazards ahead in future.

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